



DEPARTMENT OF TRANSPORTATION

National Highway Traffic Safety Administration

Denial of Motor Vehicle Defect Petition

AGENCY: National Highway Traffic Safety Administration, (NHTSA), Department of Transportation

ACTION: Denial of a petition for a defect investigation.

SUMMARY: This notice sets forth the reasons for denying a petition submitted to NHTSA, 49 U.S.C. 30162, 49 CFR part 552, requesting that the agency open “an investigation into low-speed surging in different models of Toyota automobiles in which the car starts accelerating and the engine RPM increases even when the accelerator pedal is not depressed.”

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SUPPLEMENTARY INFORMATION:

1.0 Introduction

Interested persons may petition NHTSA requesting that the agency initiate an investigation to determine whether a motor vehicle or item of replacement equipment does not comply with an applicable motor vehicle safety standard or contains a defect that relates to motor vehicle safety. 49 U.S.C. 30162(a)(2); 49 CFR 552.1. Upon receipt of a properly filed petition, the agency conducts a technical review of the petition, material submitted with the petition, and

any additional information. 49 U.S.C. 30162(c); 49 CFR 552.6. The technical review may consist solely of a review of information already in the possession of the agency, or it may include the collection of information from the motor vehicle manufacturer and/or other sources. After considering the technical review and taking into account appropriate factors, which may include, among others, allocation of agency resources, agency priorities, the likelihood of uncovering sufficient evidence to establish the existence of a defect, and the likelihood of success in any necessary enforcement litigation, the agency will grant or deny the petition. *See* 49 U.S.C. 30162(d); 49 CFR 552.8.

2.0 Petition Background Information

In a letter dated June 19, 2015, Dr. Gopal Raghavan (the petitioner) requested that NHTSA open “an investigation into low-speed surging in different models of Toyota automobiles in which the car starts accelerating and the engine RPM increases even when the accelerator pedal is not depressed.” Dr. Raghavan based his request on his analysis of EDR data from an accident involving his wife and from two other accidents in Toyota vehicles. NHTSA has reviewed the material cited by the petitioner. The results of this review and our evaluation of the petition are set forth in the DP15-005 Petition Analysis Report, published in its entirety as an appendix to this notice.

After a thorough assessment of the material submitted by the petitioner, the information already in NHTSA’s possession, and the potential risks to safety implicated by the petitioner’s allegations, it is unlikely that an order concerning the notification and remedy of a safety-related defect would result from any proceeding initiated by the granting of Dr. Raghavan’s petition. After full consideration of the potential for finding a safety related defect in the vehicle, and in view of NHTSA’s enforcement priorities, its previous investigations into this issue, and the need

to allocate and prioritize NHTSA's limited resources to best accomplish the agency's mission, the petition is denied.

Appendix - Petition Analysis - DP15-005

1.0 Introduction

On June 29, 2015, the National Highway Traffic Safety Administration (NHTSA) received a June 19, 2015 letter from Dr. Gopal Raghavan, Ph.D. EE (the petitioner), petitioning the agency “for an investigation into low-speed surging in different models of Toyota automobiles in which the car starts accelerating and the engine RPM increases even when the accelerator pedal is not depressed.” In support of this request, the petitioner provides his analysis of Event Data Recorder (EDR) data from three accidents, which he alleges, “shows a troubling similarity amongst EDRs of Toyota cars showing sudden acceleration.”

2.0 Petition Analysis

2.1 EDR pre-crash data

Since the petition is based on several misconceptions about Toyota EDR pre-crash data, a short background of this system is provided. The Toyota EDR collects pre-trigger data (vehicle speed, engine speed, brake switch status, and accelerator pedal position sensor #1 voltage) from the vehicle’s High Speed Controller Area Network (HS-CAN), which is refreshed either periodically or immediately by the respective control modules.

Parameter	Refresh Rate	Resolution
Brake Switch	Immediately	On/Off
Engine RPM	24 ms	400 RPM ¹
Vehicle Speed	500 ms	2 km/h ²
Accelerator Rate	512 ms	0.039 volts

Table 1. EDR Pre-Crash Parameters, by Refresh Rate.²

The EDR continuously performs 1 Hz sampling of HS-CAN pre-trigger data and stores the data in a temporary buffer. The EDR only saves this data, along with the trigger data, when

¹ EDR recorded data are rounded down in the indicated resolution increments.

² These values apply to ES350 and Camry vehicles involved in two of the incidents identified by the petitioner. The third vehicle, a 2010 Toyota Corolla, has a slower refresh rate for Engine RPM (524 ms).

it detects a triggering event such as a crash.³ Table 1 shows the refresh rates and resolutions for the pre-crash data signals. Any analysis of EDR data for Toyota vehicles should apply these data time tolerances and resolutions at each of the pre-crash data points.

In 2010, NHTSA's Vehicle Research and Test Center (VRTC) conducted testing to validate the EDR pre-crash data used in NHTSA field investigations.⁴ Figure 1 shows accelerator pedal sensor voltage data from one test performed by VRTC in the validation testing.⁵ As the figure shows, the EDR does not necessarily capture all accelerator pedal applications during an event and the accelerator pedal voltage recorded at each EDR time interval may not be the actual accelerator pedal voltage at that interval.

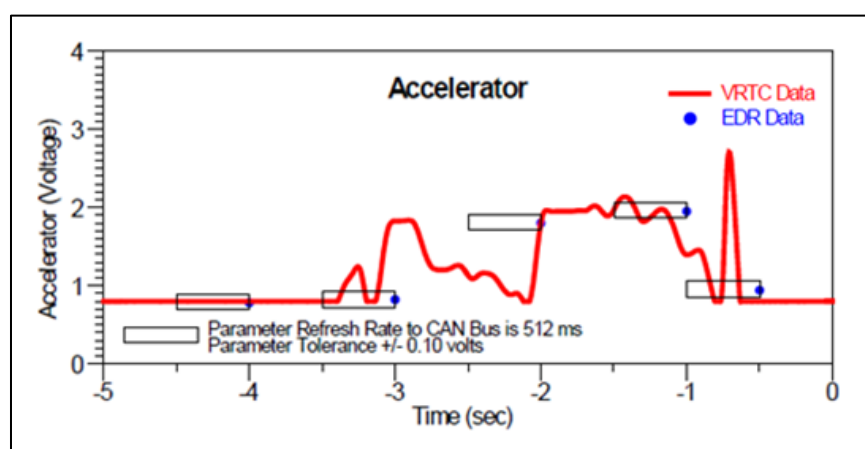


Figure 1. VRTC validation testing of EDR accelerator pedal sensor voltage from simulated collisions in a 2007 Toyota Camry.

Subsequent studies have confirmed the limitations of stored EDR pre-crash data in capturing the entire crash event due to the data refresh rates, data resolutions and EDR sampling rates.^{6,7,8}

³ An event is triggered by detection of a deceleration of approximately 2 g's.

⁴ "Event Data Recorder - Pre Crash Data Validation of Toyota Products," NHTSA-NVS-2011-ETC-SR07, February 2011.

⁵ "Event Data Recorder - Pre Crash Data Validation of Toyota Products," NHTSA-NVS-2011-ETC-SR07, February 2011, page 13.

⁶ Brown, R., White, S., "Evaluation of Camry HS-CAN Pre-Crash Data," SAE Technical Paper 2012-01-0996, 2012, doi: 10.4271/2012-01-0996.

⁷ Brown, R., Lewis, L., Hare, B., Jakstis, M. et al., "Confirmation of Toyota EDR Pre-crash Data," SAE Technical Paper 2012-01-0998, 2012, doi: 10.4271/2012-01-0998.

The Bosch CDR report provided with the petition clearly notes these issues in the first two items of Data Limitations section on page one of the report:

- **Due to limitations of the data recorded by the airbag ECU, such as the resolution, data range, sampling interval, time period of the recording, and the items recorded, the information provided by this data may not be sufficient to capture the entire crash.**
- **Pre-Crash data is recorded in discrete intervals. Due to different refresh rates within the vehicle's electronics, the data recorded may not be synchronous to each other.**

2.2 Crashes cited by petitioner

2.2.1 2009 Lexus ES350

The first incident identified by the petitioner involved a sudden acceleration accident experienced by his wife as she attempted to park the family's 2009 Lexus ES350 on Friday, February 13, 2015 (VOQ 10732103). When interviewed by ODI, Mrs. Raghavan stated that the engine roared as she was coasting into a parking space. She stated that the surge occurred before she applied the brake and that when she applied the brake there was no response or braking action. The vehicle accelerated up onto a sidewalk and into some bushes and a fence. On February 24, 2015, a Toyota representative inspected the vehicle, including a download of EDR data (Table 2).

Time (sec)	-4.6	-3.6	-2.6	-1.6	-0.6	0 (TRG)
Vehicle Speed (MPH [km/h])	3.7 [6]	3.7 [6]	3.7 [6]	3.7 [6]	5 [8]	8.7 [14]
Brake Switch	OFF	OFF	OFF	OFF	OFF	ON
Accelerator Rate (V)	0.78	0.78	0.78	0.78	2.38	0.78
Engine RPM (RPM)	400	400	400	800	1,600	1,600

Table 2. Pre-crash data for VOQ 10732103.

⁸ Ruth, R., Bartlett, W., Daily, J., "Accuracy of Event Data in the 2010 and 2011 Toyota Camry During Steady State and Braking Conditions," SAE Technical Paper 2012-01-0999, 2012, doi: 10.4271/2012-01-0999.

According to the EDR data, immediately prior to impact ($t = 0.6$ s) the brake pedal was not applied and the accelerator pedal was depressed to approximately 71 percent of full apply.⁹ Based on the recorded vehicle speeds at this time, the vehicle was inside the parking space when the acceleration occurred. At this time and distance from impact, the driver should be applying the brake and not the accelerator to safely stop the vehicle and avoid the collision. Although the driver alleged that the brakes were not effective during the incident, the brakes had no prior history of malfunction and the post-incident inspection did not identify any issues with the brake system. Based on the available information, this incident is consistent with pedal misapplication by the driver and provides no evidence of a vehicle defect.

2.2.2 2010 Toyota Corolla

The second incident identified by the petitioner involved a MY 2010 Toyota Corolla that accelerated into a parked vehicle during an attempted curbside-parking maneuver in a residential neighborhood on June 8, 2014 (VOQ 10637908). NHTSA examined this incident in Defect Petition DP14-003, which the agency closed on April 29, 2015.¹⁰

In the police report for this accident, the driver states that she stopped at an intersection with the intention of turning right and parking along the curb behind a parked vehicle. When interviewed by ODI, the driver indicated that as she applied the brakes during the incident, the car responded by accelerating. She stated that it did not slow down, and it continued to increase in speed until it hit the back of the parked vehicle. Similar to the current petitioner's incident, the EDR data for this incident (Table 3) shows no recorded service brake application until the airbag module trigger point ($t = 0$ s).

⁹ According to Toyota, an Accelerator Rate of 2.38 volts indicates an accelerator pedal application of 71 percent.

¹⁰ McHenry, S., "Denial of Motor Vehicle Defect Petition," DP14-003, May 2015.

Time (sec)	-4.8	-3.8	-2.8	-1.8	-0.8	0 (TRG)
Vehicle Speed (MPH [km/h])	3.7 [6]	3.7 [6]	3.7 [6]	3.7 [6]	5 [8]	7.5 [12]
Brake Switch	OFF	OFF	OFF	OFF	OFF	ON
Accelerator Rate (V)	0.78	0.78	0.86	0.78	0.78	0.78
Engine RPM (RPM)	800	800	800	800	800	1,600

Table 3. Pre-crash data for VOQ 10637908.

Based on the vehicle speeds recorded just prior to impact ($t = -0.8$ s), the Corolla was less than a car length from the parked vehicle and traveling 7 to 9 feet per second with no indication of service brake application. At this speed and distance, the driver should be applying the brake to safely stop the vehicle and avoid the collision. Although the recorded accelerator rate voltages do not show a pedal application corresponding with the surge,¹¹ VRTC simulation testing verified that unrecorded accelerator pedal applications could produce the increases in vehicle speed and engine speed shown by the EDR in the trigger data.¹² In addition, VRTC accumulated over two thousand miles of testing of this vehicle during DP14-003 with no problems noted in the throttle, transmission or brake systems.¹³ As previously determined by NHTSA, this incident does not provide evidence of a vehicle defect.

2.2.3 2009 Toyota Camry

The third incident identified by the petitioner involved a MY 2009 Toyota Camry that accelerated into a building when attempting to park in a storefront facing parking space on December 21, 2009 (VOQ 10299750). This incident was among 58 accidents investigated by NHTSA in 2010 as part of the joint study with NASA. A description of the incident, identified

¹¹ The data do show a small accelerator pedal application 2.8 seconds prior to the impact.

¹² Collins, W., Stoltzfus, D., "Evaluation of 2010 Toyota Corolla from DP14-003," DP14-003WDC, April 2015, pages 11-13.

¹³ Collins, W., Stoltzfus, D., "Evaluation of 2010 Toyota Corolla from DP14-003," DP14-003WDC, April 2015.

as Case 33 in the NHTSA study, was included as an example of the 39 accidents classified as pedal misapplications in a 2011 report summarizing NHTSA's field investigations.¹⁴

Time (sec)	-4.7	-3.7	-2.7	-1.7	-0.7	0 (TRG)
Vehicle Speed (MPH [km/h])	3.7 [6]	3.7 [6]	3.7 [6]	9.9 [16]	13.7 [22]	19.9 [32]
Brake Switch	OFF	OFF	OFF	OFF	OFF	OFF
Accelerator Rate (V)	0.86	0.82	0.98	0.78	3.71	1.37
Engine RPM (RPM)	400	400	800	1,600	3,200	4,400

**Table 4. Pre-crash data for VOQ 10299750,
EDR tool version 1.4.1.1.**

As described in the 2011 report, the driver had turned from a lane of traffic to enter a parking space and was about to come to a rest facing a shopping plaza storefront when the vehicle lunged forward through the façade of a hair salon. The driver reported having his foot on the brake when the acceleration occurred. Table 4 shows the EDR pre-crash data for this accident, as published in the 2011 report.¹⁵

The EDR data for this incident shows no recorded service brake application during the event. Immediately prior to impact and after the vehicle had entered the parking space, the driver pressed the accelerator pedal to the floor when intending to apply the brake.¹⁶ As noted in the 2011 report, this incident is consistent with pedal misapplication by the driver and does not provide any evidence of a vehicle defect as suggested by the petitioner.

2.3 Petitioner claims and misconceptions

2.3.1 “Strong signature”

According to the petitioner, “The fact that all three cars were coasting at 3.7 mph when the sudden-acceleration happened appears to be a strong signature of a common issue.”

However, even though the EDR data for the three incidents may have reflected speeds of 3.7

¹⁴ "NHTSA Toyota Pre-Crash EDR Field Inspections during March - August 2010," NHTSA-NVS-2011-ETC-SR10, February, 2011, pages 15-16.

¹⁵ The petitioner based his analysis of this incident on a different EDR readout reviewed later in this report, in Section 2.3.3, “Case 33.”

¹⁶ The recorded Accelerator Rate of 3.71 volts is well beyond the accelerator rate needed for 100 percent throttle.

mph before the acceleration occurred, the vehicles may not have actually been travelling the same speed. The common speeds recorded in the three vehicles are simply an artifact of the EDR vehicle speed resolution of 2 km/h. In all three incidents, the vehicles were travelling 6.0 – 7.9 km/h (3.7 – 4.9 mph) prior to the accelerations, which the Toyota EDR records as 6 km/h (3.7 mph). These are common speeds for low-speed parking maneuvers.

The “glitch” in accelerator pedal voltage that the petitioner alleges occurs after the 3.7 mph speed recording, is the voltage increase resulting from the accelerator pedal applications by the drivers. The petitioner claims that the voltage spike suggests a potential vehicle based cause, speculating, “the accelerator is either calculating an incorrect accelerator value or receiving a noise spike on the accelerator sensor.” However, such speculation ignores the facts that the accelerator pedal has redundant sensors and that NASA already thoroughly examined this subject during the joint study. The common pattern is that the “glitches” occur at the moments in the events when the driver should be initiating braking, but no braking has occurred.

Thus, the only common signature evident in the incidents is that in all three the surges occurred when the driver should have initiated braking for a vehicle entering a parking space at low speed. The fact that the vehicles suddenly accelerated just as they were beginning to enter their intended parking spaces instead of braking to a stop as intended is a signature of pedal misapplication by the driver. NHTSA has observed this signature in investigations of sudden acceleration dating back to the first such investigation that ODI opened in 1978. It is not isolated to any particular makes or models of vehicles or to any throttle design technologies.

2.3.2 Engine RPM increases

The petitioner claims that each of the incidents he analyzed displays evidence of engine speed increases without any application of the accelerator pedal. For example, in his analysis of

his wife's incident he states, "by -1.6 seconds the engine RPM has DOUBLED to 800 with no depression of the accelerator." This assertion reflects a misunderstanding of the manner in which the Toyota EDR samples and records pre-crash data as previously described in this report and in prior reports published by NHTSA.

First, as indicated in this report and in the Data Definitions section on page two of the Bosch CDR report attached to the petition, the Toyota EDR records engine speed in 400 rpm increments (rounded down). For example, a recorded value of 400 rpm indicates that the measured engine speed was between 400 and 799 rpm. Thus, an increase in recorded engine speed from 400 to 800 rpm could result from a change in engine speed of just 1 rpm.

Second, the nominal idle speed for a MY 2009 ES350 when the engine is warm, the transmission is in gear (i.e., either Drive or Reverse), and no accessory loads are operating is approximately 600 rpm. Air-conditioning use and steering input may result in the idle speed increasing to 700 to 800 rpm to compensate for the additional loads placed on the engine by the air-conditioning compressor and power-steering pump. Thus, the actual engine speeds associated with the recorded values of 400 rpm were likely closer to 800 rpm than 400 rpm.¹⁷

Finally, it is not accurate to state that engine speed increases did not result from accelerator pedal applications based strictly on the recorded EDR data, since the data do not necessarily show all accelerator pedal applications (see section 2.1 and Figure 1) and because of the differences in refresh rates for engine speed and accelerator rate. Although actual engine speed will closely follow accelerator rate, the recorded accelerator rate may slightly lag behind recorded engine speed due to the slower refresh rate of the accelerator signal (see Table 1).

Thus, the increase in recorded engine speed at -1.6 seconds prior to impact could very well have

¹⁷ Engine speeds that drop below 500 rpm are uncommon in motor vehicles and have been associated with engine stall due to idle undershoot in some ODI investigations of non-Toyota products.

resulted from the initial stages of the large pedal application that the EDR recorded at -0.6 seconds.

2.3.3 Case 33

The EDR data used by the petitioner for Case 33 was from the initial readout ODI performed with the original version of software available from Toyota (Table 5). This version converted accelerator pedal sensor #1 voltages to an accelerator status of OFF, MIDDLE or FULL. A supplemental report to the NHTSA February 2011 report included a copy of this readout.¹⁸ This incident is one of many incidents from early field investigations that ODI read a second time after receiving an updated version of Toyota software that provided a more precise indication of accelerator pedal position.¹⁹

Time (sec)	-4.7	-3.7	-2.7	-1.7	-0.7	0 (TRG)
Vehicle Speed (MPH [km/h])	3.7 [6]	3.7 [6]	3.7 [6]	9.9 [16]	13.7 [22]	19.9 [32]
Brake Switch	OFF	OFF	OFF	OFF	OFF	OFF
Accelerator	OFF	OFF	OFF	OFF	FULL	OFF
Engine RPM (RPM)	400	400	800	1,600	3,200	4,400

**Table 5. Pre-crash data for VOQ 10299750,
EDR tool version 1.3 (original readout).**

Table 4 shows the data from the readout obtained using the updated software. Rather than maintaining a consistent voltage as may be misinterpreted by the OFF accelerator levels shown in Table 5, the accelerator pedal rates in the updated readout in Table 4 show that the driver was applying the accelerator pedal at varying rates throughout the event. Thus, the petitioner's conclusions that the vehicle was coasting and the driver had not depressed the accelerator pedal when the idle speed was increasing are incorrect and do not provide evidence of a vehicle defect.

¹⁸ "Toyota EDR Data from NHTSA Pre-Crash Field Inspections," NHTSA-NVS-2011-ETC-SR12, February 2011.

¹⁹ "Toyota EDR Software Versions Used in NHTSA Unintended Acceleration Field Investigation Cases," NHTSA-NVS-2011-ETC-SR08, February 2011, page 8.

2.3.4 NASA “high-speed study”

The petitioner incorrectly characterizes the joint NASA-NHTSA study as a “high-speed study.” In fact, the joint study focused on all potential vulnerabilities in the Toyota ETCS-i system that were not associated with the floor mat entrapment or sticking accelerator pedal conditions addressed by multiple Toyota safety recalls in 2009 and 2010.²⁰ Most such incidents examined during the study involved allegations of sudden acceleration in vehicles initially moving at low speeds. The most common scenario for the incidents was acceleration when attempting to park. Thus, contrary to the petitioner’s characterization, low-speed surges were the primary focus of the study by NHTSA and NASA in 2010.

The incidents analyzed by the petitioner fall within the scope of prior work conducted in the joint NHTSA-NASA study of Toyota ETCS-i and, more recently, the analysis conducted in evaluating Defect Petition DP14-003. His claims appear to be based on upon several misconceptions regarding the manner in which Toyota EDR sample and record data, as well as a misunderstanding of the scope of and results from prior work conducted by NHTSA, NASA and others related to sudden unintended acceleration and the use of EDR data in related field investigations. The petitioner has presented no new evidence or theories not already considered by NHTSA that warrant reconsideration of any of the analyses or conclusions from that prior work.

3.0 Conclusion

In our view, a defects investigation is unlikely to result in a finding that a defect related to motor vehicle safety exists, or a NHTSA order for the notification and remedy of a safety-related

²⁰ The floor mat entrapment and sticking pedal defect conditions were both “stuck throttle” type defect conditions, which typically occur at higher speeds when larger accelerator pedal applications necessary to cause the entrapment are more likely.

defect as alleged by the petitioner, at the conclusion of the requested investigation. Therefore, given a thorough analysis of the potential for finding a safety related defect in the vehicle, and in view of NHTSA's enforcement priorities, its previous investigations into this issue, and the need to allocate and prioritize NHTSA's limited resources to best accomplish the agency's safety mission and mitigate risk, the petition is denied. This action does not constitute a finding by NHTSA that a safety-related defect does not exist. The agency will take further action if warranted by future circumstances.

Authority: 49 U.S.C. § 30162(d); delegations of authority at 49 CFR §§ 1.50 and 501.8.

Frank S. Borris II
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Billing Code: 4910-59-P

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